What is claimed is:

1.   A map displaying apparatus that displays a map, comprising:

a map data storing unit operable to store map data;

a sound data obtaining unit operable to obtain sound data; and

5   an image generating unit operable to generate map drawing data based on the map data stored in the map data storing unit and the sound data obtained from the sound data obtaining unit.

2.   A map displaying apparatus according to Claim 1,

10   wherein the map data is data relating to at least one three-dimensional object, and

the image generating unit changes one of a shape and a position of the at least one three-dimensional object in accordance with changes in the sound data.

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3.   A map displaying apparatus according to Claim 2,

wherein the shape is changed by changing a height of the at least one three-dimensional object.

20   4.   A map displaying apparatus according to Claim 3,

wherein the image generating unit includes:

an object generating unit operable to fetch the map data stored in the map data storing unit, specify local coordinates of vertices of the at least one three-dimensional object, and carry out a generating

25   process for the at least one three-dimensional object;

a local coordinate transformation matrix changing unit operable to fetch the sound data from the sound data fetching unit and change, using the sound data, a local coordinate transformation matrix for transforming the local coordinates to global coordinates;

30   a local coordinate transforming unit operable to transform the local coordinates of the vertices of the at least one three-dimensional object to global coordinates using the matrix changed by the local

coordinate transformation matrix changing unit;

a model view transforming unit operable to specify viewpoint coordinates for a viewpoint in the global coordinates, and generate the map drawing data by transforming the global coordinates to a
5   coordinate system centered on the viewpoint coordinates using a model view transformation matrix.

5.   A map displaying apparatus according to Claim 4,

wherein the local coordinate transformation matrix is a four-row,
10   four-column transformation matrix, and

the local coordinate transformation matrix changing unit changes a value of a second row, second column element in the local coordinate transformation matrix based on the sound data.

15   6.   A map displaying apparatus according to Claim 1,

wherein the map data is data relating to three-dimensional objects, and

the image generating unit changes color data applied to the at least one three-dimensional object based on changes in the sound
20   data.

7.   A map displaying apparatus according to Claim 6,

wherein the image generating unit includes

an object generating unit operable to fetch map data stored in
25   the map data storing unit, to specify local coordinates of vertices of the at least one three-dimensional object, and carry out a generation process for the at least one three-dimensional object;

an object coloring changing unit operable to obtain color data of the at least one three-dimensional object stored in the map data
30   storing unit and change the color data based on changes in the sound data obtained from the sound data obtaining unit;

a local coordinate transforming unit operable to set a local

coordinate transformation matrix for transforming the local coordinates to global coordinates and transform the local coordinates to global coordinates using the local coordinate transformation matrix; and

5   a model view transforming unit operable to specify viewpoint coordinates for a viewpoint in the global coordinates, and generate the map drawing data by transforming the global coordinates to a coordinate system centered on the viewpoint coordinates using a model view transformation matrix.

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8.   A map displaying apparatus according to Claim 7,

wherein the object coloring changing unit obtains (a) color data of top vertices of the at least one three-dimensional object, and (b) color data of base vertices of the at least one three-dimensional object

15   from the map data storing unit, and changes the color data of at least one of (a) and (b) based on the sound data obtained from the sound data obtaining unit.

9.   A map displaying apparatus according to Claim 8,

20   wherein the object coloring changing unit carries out a gradation process for a color of the top vertices and a color of the base vertices of the at least one three-dimensional object after changing to change intermediate color data of the at least one three-dimensional object.

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10.   A map displaying apparatus according to Claim 1,

wherein the map data is data relating to at least one three-dimensional object, and

the image generating unit changes a display region for the at

30   least one three-dimensional object on a screen based on changes in the sound data.

11.   A map displaying apparatus according to Claim 10,

wherein the image generating unit includes:

a three-dimensional display region setting unit operable to set the display region for the at least one three-dimensional object based on changes in the sound data obtained from the sound data obtaining unit;

an object generating unit operable to fetch map data stored in the map data storing unit for the three-dimensional display region set by the three-dimensional display region setting unit, specify local coordinates of vertices of the at least one three-dimensional object, and carry out a generation process for the at least one three-dimensional object, and to not fetch map data stored in the map data storing unit nor carry out a generation process for three-dimensional objects for a non-three dimensional display region set by the three-dimensional display region setting unit;

a local coordinate transforming unit operable to set a local coordinate transformation matrix for transforming the local coordinates to global coordinates and transform the local coordinates to global coordinates using the local coordinate transformation matrix; and

a model view transforming unit operable to specify viewpoint coordinates for a viewpoint in the global coordinates and generate the map drawing data by transforming the global coordinates to a coordinate system centered on the viewpoint coordinates using a model view transformation matrix.

12.   A map displaying apparatus according to Claim 11,

wherein the three-dimensional display region setting unit divides the three-dimensional display region into two in one of an up-down direction and a left-right direction of the screen and sets one divided part as the three-dimensional display region and another divided part as the non-three-dimensional display region

13.   A map displaying apparatus according to Claim 1,

wherein the map data is data relating to at least one three-dimensional object, and

5   the image generating unit carries out a process that shakes top vertices of the at least one three-dimensional object based on changes in the sound data.

14.   A map displaying apparatus according to Claim 13,

10   wherein the image generating unit includes:

an object generating unit operable to fetch the map data stored in the map data storing unit, specify local coordinates of vertices of the at least one three-dimensional object, and carry out a generating process for the at least one three-dimensional object;

15   a local coordinate transforming unit operable to set a local coordinate transformation matrix for transforming the local coordinates to global coordinates and transform the local coordinates to global coordinates using the local coordinate transformation matrix;

a model view transforming unit operable to specify viewpoint

20   coordinates for a viewpoint in the global coordinates and transform the global coordinates to a coordinate system centered on the viewpoint coordinates using a model view transformation matrix; and

a coordinate changing unit operable to obtain the sound data from the sound data inputting unit and generate the map drawing data

25   by carrying out a process that changes a matrix transformed by the model view transforming unit based on changes in the sound data.

15.   A map displaying apparatus according to Claim 14,

wherein the coordinate changing unit carries out a process that

30   translates all top vertices of the at least one three-dimensional object in a certain direction.

16.   A map displaying apparatus according to Claim 14,

        wherein the matrix transformed by the model view transforming unit is a four-row, four-column matrix, and

        the coordinate changing unit changes a second row, third column element of the matrix based on changes in the sound data.

17.   A map displaying apparatus according to Claim 1,

        wherein the map data is data relating to mesh data forming at least one mountain object, and

        the image generating unit changes color data relating to colors of a mesh included in the mesh data based on changes in the sound data.

18.   A map displaying apparatus according to Claim 17,

        wherein the image generating unit includes:

        a color data changing unit operable to change the color data included in the mesh data forming the at least one mountain object based on changes in the sound data obtained from the sound data obtaining unit;

        an object generating unit operable to specify local coordinates of vertices of the at least one mountain object using the mesh data including the color data changed by the color data changing unit and carry out a generation process for the at least one mountain object;

        a local coordinate transforming unit operable to set a local coordinate transformation matrix for transforming the local coordinates to global coordinates and transform the local coordinates to global coordinates using the local coordinate transformation matrix; and

        a model view transforming unit operable to specify viewpoint coordinates for a viewpoint in the global coordinates and generate the map drawing day by transforming the global coordinates to a coordinate system centered on the viewpoint coordinates using a

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model view transformation matrix;

19.   A map displaying apparatus according to Claim 18,

wherein the color data changing unit changes the color data
included in the mesh data from a summit side of the at least one
mountain object.

20.   A map displaying apparatus according to Claim 17,

wherein the mesh data includes altitude data composed of
heights above points in a lattice oriented with longitude and latitude
directions to express undulations in a land surface, shape data of the
mesh, and color data of the mesh.

21.   A map displaying apparatus according to Claim 1,

wherein the image generating unit includes a region division
unit operable to divide a region of a screen based on frequency bands
of the sound data obtained from the sound data obtaining unit, and
generates the map drawing data separately for each region produced
by division by the region division unit.

22.   A map displaying apparatus according to any of Claim 1 to Claim
21,

wherein the image generating unit includes:

a projection matrix changing unit operable to change a
projection transformation matrix for projecting the at least one
three-dimensional object onto two-dimensional coordinates based on
sound data obtained from the sound data obtaining unit; and

a projection transforming unit operable to project and transform
a matrix after model view transformation using the projection
transformation matrix changed by the projection matrix changing unit.

23.   A map displaying apparatus according to Claim 1,

wherein the sound data includes at least one of data relating to magnitudes of sounds and data relating to magnitudes of sounds in respective frequency bands.

5   24.   A map displaying method for displaying a map, comprising:

a map data storing step of storing map data;

a sound data obtaining step of obtaining sound data; and

an image generating step of generating map drawing data based on the map data stored in the map data storing step and the sound

10   data obtained in the sound data obtaining step.

25.   A program for a map displaying apparatus that displays a map, comprising:

a map data storing step of storing map data;

15   a sound data obtaining step of obtaining sound data; and

an image generating step of generating map drawing data based on the map data stored in the map data storing step and the sound data obtained in the sound data obtaining step.